# DEVELOPMENTAL THEORY AND THE PSYCHOLOGY OF MUSIC

JOEL FUNK AND JOHN WHITESIDE

To date, developmental theory and empirical investigations of the musical abilities of children have had little mutual overlap or influence. Most research has not been founded on any of the major theories of perceptual or cognitive development and most theorists and their exponents have not attempted applications to the area of musical development. The major exception is the line of thought originated by Pflederer (1964, 1967), which postulates the notion of "conservation of musical properties" in the face of change, much as in Piaget's well-known conservation studies (Flavell, 1963). There are reasons, however, discussed below, to consider Piaget's cognitive theory inappropriate as a basis for understanding the growth of musical ability.

The purpose of this paper is to consider six theories of development, propounded by five different theorists: Howard Gardner, Jean Piaget (two independent theories), Heinz Werner, Joachim Wohlwill and Eleanor Gibson, with regard to their effectiveness in providing a framework for comprehending musical development. As concrete illustrations of how the theories may be applied to research, three frequently investigated abilities will be employed: recognition of variation on a theme, discrimination of variation from theme and perception of tonality. These three tasks were chosen partly due to their interest for us (Funk, 1977; Funk and Whiteside, 1980) as well as for their centrality in the field of music research (see, for example, Petzold, 1969; Pflederer-Zimmerman and Sechrest, 1970; Zenatti, 1970, 1973; Taylor, 1976; Dowling and Hollombe, 1977; Prince, 1977; Davies, 1978).

To recognise a variation on a theme, a listener must abstract the invariant elements common to both versions, even if the correct version is simply a standard stored in memory. To discriminate variation from theme, one must ignore the dominant Gestalt and attend to the variable features of the piece. Finally, grasping the tonal nature of a melodic sequence requires that the temporal succession of notes and chords be integrated around a tonal centre, which serves as an anticipated point of return. Below we will consider how each theory provides a means for comprehending these and other musical abilities in greater detail.

Each of the five theorists may be categorised as either "technical-geometric" or "physiognomic" in orientation. Geometric perception is essentially static and limited to the measurable properties of stimuli. Physiognomic perception. in contrast, is concerned exclusively with their dynamic and affective qualities. For example, one can look at a mountain in terms of its height or climatological conditions (geometrically) or in terms of the sense of majesty it conveys (physiognomically). In general, art has been seen as the appropriate medium for studying physiognomic properties of perception, while the scientific-logical realm has been approached more formally. We, however, are concerned with a third possibility —a technical view of artistic processes. For this, we must determine the potential relevance of each of the developmental positions.

Gardner (1973a) is concerned primarily with the physiognomic properties of artistic activity; the technical-geometric aspects of artistic perception are dealt with only in passing. Piaget (Flavell, 1963), in contrast, has examined the growth of logical and scientific thinking almost exclusively. There are certain facets of this highly formalised theory, however, that will allow some understanding of musical perception. Werner (1961) has examined the worlds of both



from the SAGE Social Science Collections. All Rights Reserved.

artist and scientist, tending to see the former as being dominated by physiognomic and the latter by technical-geometric processes. Werner, however, was one of the few writers to apply his theory to musical perception, and he carried out several pertinent experiments in this field. Wohlwill (1970) and Gibson (1969) treat perception and conception as essentially continuous. Thus, their theories are equally applicable to the perceptual processes of the artist and the most abstract thought of the scientist.

*Howard Gardner.* Gardner's (1973a) *The Arts and Human Development* is a broad synthesis of Piaget, Werner, Erikson and others, with many original ideas interwoven. In contrast to Piaget, whose end point is the adult capable of hypothetico-deductive reasoning, Gardner poses the child as artist as his terminus. Participation in the arts is, he maintains, a more universal accomplishment than participation in the sciences, and one which is achieved well before adolescence.

Indeed, in his view, the means by which the child relates to the world are essentially those of the artist. Borrowing from Erikson, Gardner portrays the child's—and the artist's—aesthetic perception in terms of the "modal/vectoral" properties of things. This is comparable with, if not identical to, Werner's notion of "physiognomic perception". Examples of modal dimensions are "getting", "grasping", "holding onto" and "going into", while vectoral qualities include speed, regularity, repletion (hollow *v.* full), boundedness, force, depth and texture. While children are relatively slow to learn the geometric nature of things, they rather rapidly accommodate to the modal/vectoral properties of objects. As Gardner writes:

> The child of 7 or 8 has, in most respects, become a participant in the artistic process and he need not pass through any further qualitative reorganizations. (p. vi)
>
> I will contend that children of this age are sensitive to formal aspects of the arts. . . . A reasonably competent 7-year-old should understand the basic metrical properties of his musical system and the appropriate scales, harmonies, cadences and groupings, even as he should be able, given some motifs, to combine them into a musical unit that is appropriate for his culture. (pp. 178, 197)

Considering the empirical literature, Gardner may be overstating his case somewhat; awareness of harmonic structure is generally not in evidence by age seven (Rupp, 1915; Imberty, 1969).

Gardner's main point is that the child's growing familiarity with the modal/vectoral properties of objects, combined with a gradual mastery of symbolic media entitles him to be considered a true artist by about age seven. There are only three stages of artistic development in his schema: a presymbolic period, which occupies the first year or so of life; a period of developing symbol use, to about seven years, in which language, music and other symbolic media are incorporated and amplified; and a period of later artistic development, from age eight on. Development past age seven involves, not qualitative reorganisation to higher levels, but rather continuous refinement of what he calls the "three systems" of making, feeling and perceiving. With the exception of the restructuring of the world effected by symbol usage, artistic development is viewed as continuous.

Making, feeling, and perceiving are the means of interacting with the modal/vectoral properties of objects. Logical thought is conspicuously absent from this trio as it does not function in this manner. Operational thinking, so vital to the scientific domain, is considered unnecessary to artistic growth. Gardner maintains "that the development of operational thought is not a vital part of artistic development; indeed it may sometimes be inimical to it" (p. 305). Indeed,

Gardner (1973b) has performed an ingenious experiment on children's sensitivity to musical style, *i.e.* the modal/vectoral properties of compositions, in which the potentially inhibiting effects of operational intelligence are demonstrated. In this study, children aged 6 to 19 were required to compare the styles, *e.g.* Baroque, Romantic, etc., of pairs of musical themes. The most interesting discovery was that the 11-year-olds performed as well or slightly better than the groups aged 14 to 19. Apparently the excessive analytical introspection of the older subjects was a hindrance to success. It is possible, however, that given a task demanding fine discriminations or detailed comparisons, the older subjects would have been superior (Francès, 1958).

Unfortunately, Gardner has less to say about the development of the geometric-technical aspects of artistic perception that form the bulk of research in the psychology of music. He does, however, discuss briefly two facets of perception that are relevant to our own inquiry. These he calls Gestalt perception and Gestalt-free perception (1973a). The former he defines as "the ability to discern and recognize identities among patterns or objects, even when they appear in different contexts or guises" (p. 66). He continues, "Gestalt perception is particularly valuable in dealing with those dense symbol systems involved in the arts whose elements cannot be readily specified, but which present coherent configurations" (pp. 66–67). Clearly Gestalt perception is essential for recognition of a theme in many varied forms and probably for maintenance of a tonal centre throughout the progressions of a melody. Gestalt-free perception is "the capacity to look beyond the dominant figure or Gestalt in some kind of presentation; the observer pays attention instead to the fine details . . . which cut across figure and ground. . . . This . . . capacity is crucial in the perception of artistic objects" (p. 68). Gestalt-free perception is obviously necessary for making discriminations between theme and variation. Gardner notes that, as expected, both forms of perception become increasingly sophisticated and flexible with age and/or experience. Gestalt perception, however, may be the earlier of the two to appear. With growing dependence on language the child becomes more object oriented, developing a world-view Gardner calls "thing perception". If the Gestalt dominates, the fine details are apt to be lost, which leads to the conclusion that recognition ought to be an easier task than discrimination for children at this stage. For a "thing dominated" six-year-old, any melody that sounds like *Jingle Bells* is *Jingle Bells* (Pflederer-Zimmerman and Sechrest, 1970).

Gardner's approach provides a broad perspective for understanding the development of certain musical skills. His emphasis on the growth of modal/vectoral perception contrasts with and complements the concerns of most other theorists for the growth of formal thought processes. We must still take issue, however, with some of Gardner's assertions. Experimental evidence (Shuter, 1968; Zenatti, 1973) strongly suggests that much musical structure, *e.g.* harmony and tonality, is still invisible to the average seven-year-old.

*Jean Piaget.* Piaget has formulated two theories; one is concerned with cognitive development (Flavell, 1963), the other with perception (1969). Both are considered below.

(*a*) Cognitive development. Piaget's framework is based on descriptions of the abstract, formal properties of thought. These descriptions are called *mental structures*. Individuals at different levels of development possess different mental structures, and the structures at each level have been specified by Piaget and his co-workers in massive detail (Piaget, 1950; Piaget and Inhelder, 1956; Flavell, 1963). Mental structures which strongly organise cognitive acts are called operations, and typically appear at higher levels of development. Operations, according to this theory, may be either *logical* or *infralogical*; the latter are concerned with concrete relationships such as position, time, and distance,

while the former are concerned with more abstract relationships such as number and mass, in which considerations of spatial and temporal position, proximity, etc., are essentially irrelevant. A child's perception of musical structure would probably be based on infralogical operations, since temporal and spatial factors are the essence of musical form.

Younger children are typically "pre-operational". Piaget (Flavell, 1963) has tested children at this level for the ability to recognise some invariant property of an otherwise changing stimulus. For example, children past age 12 generally can recognise that two containers have equal volumes even if the physical dimensions of the containers are different. Such recognition of invariance is called *conservation*. Several investigators (Pflederer, 1964, 1967; Pflederer-Zimmerman and Sechrest, 1970; Taebel, 1974; Botvin, 1974; Foley, 1975; Perney, 1976; Norton, 1979) have tested children's ability to "conserve" musical properties such as rhythm and melody. If the idea of "music conservation" is tenable, it might provide a model for the recognition of variation on a theme. That is, the theme itself could be seen as "conserved" in the variation. There are, however, two problems with this approach.

First, in Piaget's conservation studies, the child watches the experimenter transform the appearance of an object, whereas a transformed musical theme can only be presented after the variation has been accomplished. Thus, there is no on-going transformation process which the child can observe. Beilin (1969), however, proposed that children can recognise invariance in situations where they only observe stimuli in fixed states. He called such recognition *quasi-conservation*. Beilin studied the quasi-conservation of area; children had to recognise that two different arrangements of squares had the same area. One possible strategy would be to match each square from one arrangement with one square from the other; if no unmatched squares remain, the areas are equal. This strategy is called *iteration*. This suggests, at best, an *analogy* to what might occur when a child must identify theme and variation. The conservation tasks of Piaget and Beilin are all quantitative; in comparing two versions of a melody quantitative elements are of secondary importance. Iteration might be helpful in comparing the number of notes or the duration of the pieces, but the important elements—melody, harmony, rhythm—are qualitative.

This points directly to the second problem. In the classic conservation study some quantitative property such as volume is kept constant, while the stimulus is made longer and thinner. Conservation requires an exact compensation; thus "longer" and "thinner" "logically multiply" to preserve the quantitative identity. However, no abstract, quantitative property is preserved when a theme is varied. The variant *is* to some degree a different piece and one does not match it to the original by "multiplying" pitches or rhythms. Thus, Gardner criticised Pflederer's (1964, 1967) usage of the term "conservation": "There is a sense in which *any* change in a musical stimulus makes it different and that, as a consequence, analogies with Piaget's research are forced" (1973a, p. 194). The crux of the problem, then, is that recognising musical invariance is essentially a matter of preserving *qualitative* rather than quantitative identity.

Let us now consider discrimination. Discrimination requires that the listener attend to several aspects of a piece simultaneously, particularly if only one element is being varied, *i.e.* the listener must *decentre* (Piaget, 1950) from the dominant melodic figure. If attention is centred, say, on melodic contour alone, the listener will be unable to differentiate between minor and major versions of the same piece, for both share the same contour. To the centred ear, much of the musical structure of a theme is invisible, or rather inaudible. When Piaget refers to decentring as a cognitive process he generally refers to its role in facilitating conservation. As we have argued, conservation does not appear to

apply to the musical realm and it is not likely that decentring in its strictly cognitive usage does either.

Inhelder and Piaget (1964) described a response to a classification task that might provide a model for the development of tonal sense. Children were presented with a number of blocks, which differed in shape, colour and shading, and were asked to put them together so that "they were all the same". Four- to six-year-olds usually organised the blocks so that the criteria for alignment fluctuated periodically. For example, one boy started by aligning five rectangles, the fifth of which was yellow. This led him to switch criteria, so that he next picked four yellow triangles, followed by two yellow semi-circles. These in turn led to five more semi-circles of different colours. This forgetting of criteria might be analogous to what occurs when a child shifts key after each breath—the initial tonal centre fades and is replaced by another, suggested perhaps by the last few notes heard. Again, however, it is debatable whether tonal organisation is equatable with a classificatory rule.

Piaget's theory of cognitive development provides many suggestive analogies for understanding the musical tasks being considered. Yet, it is inadequate for the reason given above: the precise, logically exact nature of operational thought is distinct from the more qualitative processes involved in, say, recognising a variation on a theme.

(*b*) Perceptual development. Unlike operational thinking, which becomes increasingly abstract, perception, according to Piaget (1969), always remains at least partially limited to what is concretely given. For this reason, Piaget's perceptual theory may provide a model for understanding musical development.

The simplest form of perception is called an *encounter*, which is temporally and spatially *centred, i.e.* focused, on a minimal number of stimulus elements. One can easily experience this sense of being centred by looking at the world through a narrow tube. It is possible, however, to co-ordinate several encounters and thus attain a more complete perception of stimuli (Piaget, 1969). The co-ordination of encounters involves a *decentring* from a single point of focus to a more inclusive perspective. For example, what appears to decentred perception as a square in its entirety, will appear to a centred perception as an unrelated sequence of straight lines, corners and empty space.

Piaget (1969) has described a variety of complex mechanisms for co-ordinating encounters; these he calls perceptual *regulations*. Generally the ability to perform these regulations increases with age and experience. Even in their most developed form, however, regulations never quite attain the status of operations. While the latter are exact and reversible, the former are at best only approximate and semi-reversible. As an example, consider the conservation of volume experiments. The child at the operational level knows that the amount of water in one beaker is exactly the same when transferred to a second beaker of differing shape, and that the order of pouring is irrelevant. Purely perceptual estimations of the same event would most likely lead the child to conclude that the amounts were only approximately identical; further, the direction of pouring might well be an influential factor. The "logical multiplication" of operational thought allows an exactness not attainable by perceptual judgements. For this reason Piaget (1969) treats perception as inferior to operational thought as a means of gaining knowledge. Wohlwill (1970), however, pointed out that when dealing with judgements of identity or difference among discrete categories of stimuli—as in recognising and discriminating theme and variation—perception may well approach the reliability of operational thinking.

The most complex regulation is what Piaget (1969) calls *perceptual schematisation*. After repeatedly observing identical or related stimuli, a generalised scheme

can be formed, which includes the structures common to all cases. Later, variations of the pattern of stimuli initially encountered can be assimilated by the scheme. For example, people can discriminate male and female faces by employing a scheme which contains expectations as to the roundness, hairiness, smoothness, and size of the various features. A novel face can thus normally be recognised instantly as either male or female. Similarly a melodic scheme allows the listener to recognise a melody even when varied, and to differentiate the variation from the original. If the schematisation is vaguely defined, however, recognition and discrimination ought to be limited. For example, if a child has only a vague sense of the pitch of the third tone of the scale, major and minor thirds, which differ by a half-tone, ought to be indistinguishable. A more precise scheme would allow their discrimination.

A second regulation is called *transposition*. This involves a point-to-point or feature-to-feature comparison between two stimuli. In deciding whether two twins are identical, for example, an observer will compare a number of features of one face to the corresponding features of the other. Transposition is likely to be involved in comparing theme and variation, in that rhythmic and melodic intervals, harmonic patterns, etc., will be matched when recognition occurs and will fail to match when discrimination occurs. Unlike iteration, which compares quantities exactly, transposition is a comparison of qualitative or only approximately quantitative elements. The more sophisticated the ability to transpose elements, the more precise the recognition and discrimination. A centred perception, on the other hand, would compare only highly selected features of the melody and thus lead to poor capacity for discrimination and recognition.

A third regulation, *perceptual anticipation*, involves the expectation that certain features of a stimulus will follow from what has already been observed. One generally anticipates that a person will have two arms, even when both are not visible; surprise follows the occasional discovery of a person who is missing an arm. Anticipation probably plays an important role in the perception of tonality, since the listener gradually comes to expect that the tonal centre of the piece will remain constant through to the conclusion. When this anticipation is violated, the listener then has a sense of the key modulating or wandering. The child unable to anticipate the ending will not be likely to detect a modulation in the middle of the piece. It should be kept in mind that the various regulations usually work in tandem, and are treated here in isolation for the sake of clear exposition.

Although Piaget (1969) concentrated on visual perception and has not emphasised the importance of higher order perceptual regulations, his theory of perceptual development, by extension, appears to provide a suitable framework for understanding the development of musical perception.

*Heinz Werner*. Werner (1961) defines development in his well-known orthogenetic principle: in any system development is characterised by increasing *differentiation* and hierarchic *integration*. Differentiation means that the parts are clearly delineated from each other; integration, that the parts are centralised with respect to the whole. Primitive perception tends to be *diffusely* organised, dominated by "qualities-of-the-whole". A first impression of a face or painting, for example, is generally rather diffuse; with increased exposure the details are differentiated or *articulated*.

Diffuse organisation usually implies *inflexibility*. Stimuli perceived by an articulated perception can be modified considerably without losing their essential character; *i.e.* the invariant elements remain in sharp contradistinction to the variable elements. To the diffuse perception, however, variation may indicate that the entire stimulus has been changed. It would not be surprising then to

observe, in a child with a diffuse conception of a melody, a concommitant inability to recognise alterations of the original theme. Older listeners, presumably possessing a more articulated notion of a given melody, ought to be better at abstracting the invariant elements despite some change in the melody.

Discrimination is likely to suffer in young children as well. Poorly articulated and centralised perceptions often cause the observer to identify different stimuli, solely on the basis of some shared "qualities-of-the-whole". Werner (1961) summarised an experiment by Muchow which demonstrated that young children frequently identified three similar, but, to an adult, obviously distinct, visual forms. From Werner's perspective, it is understandable that a six-year-old would consider two different playings of *Jingle Bells* as identical.

Possession of a strong tonal sense is likewise beyond the capacity of a diffusely organised perception; instead of integrating the temporal succession into a centralised tonal framework, there is likely to be a "chain type" or "paratactic" organisation of notes (Werner, 1961, p. 208). That is, in the place of a strong centralised tonality, there are a succession of unrelated tonal "units", loosely linked together. A child possessing a paratactic sense of tonality would be unlikely, therefore, to detect modulations.

Werner conducted several investigations of the genesis of musical ability. In one study (Werner, 1961) he looked at spontaneous melodies produced by children aged two to five. Development along a variety of musical dimensions was demonstrated. For example, while the two- and three-year-old characteristically conceives the melody globally, the five-year-old has some ability to differentiate and integrate parts of a melody, such that his songs are made up of several phrases organised into something approaching a "key".

Werner also carried out two studies of microgenesis, the development of musical perception within a relatively short time period. In one study (Werner, 1961) he presented listeners with two tones separated by only a few vibrations. While initially the tones were not clearly distinguishable, the interval gradually "stretched out" subjectively, so that ultimately subjects could discriminate between them. An analogous mechanism may be at work in the development of a precise sense of pitch and interval between the sixth and tenth year. In this manner the major and minor third, only a half-tone apart, may become differentiated.

Werner's other study (1940) was concerned with subjects' familiarisation with "micro-scales" and "micro-melodies". Werner demonstrated that subjects could adapt, by a process of enlargement similar to that described above, to a musical scale compressed such that the difference between successive notes was only ·12 of a semi-tone. Eventually this tiny interval achieved the subjective character of a real semi-tone, and micro-melodies built on the micro-scale were treated as "real" melodies. Furthermore, for many subjects the intervals 1–8 and 1–13 took on the characteristics of the fifth and octave of the normal diatonic scale.

Werner's (1940) study charts in microcosmic form many of the processes in which psychologists of music are interested. The development and stabilisation of tonal sense is elegantly demonstrated, as is the emerging ability to articulate individual notes and key landmarks such as the fifth.

The organismic-developmental theory of Werner provides another framework for understanding the genesis of musical perception.

*Joachim Wohlwill and Eleanor Gibson.* Gibson's (1969) differentiation theory and Wohlwill's (1970) specificity model will be treated together, as they espouse remarkably similar positions. Unlike Piaget and Werner, Gibson and Wohlwill are not particularly concerned with the process of constructing the perceptual world through "mentalistic phenomena" such as schemas. They assume instead

that the perceptual features of the world are given; perceptual development then refers to an increase in the ability to extract and organise information from the environment, as a result of experience. Gibson's theory can be applied to the differentiation of musical forms and, in fact, she refers in her text to the work of Francès. She has asserted that the ability to abstract the variant and invariant elements of a musical piece ought, by definition, to improve with development.

Wohlwill (1970) had posited three dimensions of the transition from perception to inferential or operational thinking:

1. *Redundancy*. Development is characterised by a decreasing reliance on redundant stimulation. Redundancy refers to the duplication or repetition of information from a variety of sources; the more developed the perception the less dependent the person is on redundant cues for identification, discrimination, etc. The young child, he maintains, needs "a greater variety of cues than the adult to maintain invariance in his perception" (1960). This has been verified in the visual sphere in studies by Gollin (1956) in which subjects identified figures on the basis of partial cues; it was found that the amount of information necessary for identification decreased with development. A logical extension of this is that older listeners ought to be able to recognise deformed melodies more easily when only minimal invariant information is presented.

2. *Selectivity*. Development is marked by the differentiation of relevant from irrelevant cues. For recognition of a varied theme, the relevant cues are the invariant elements common to both playings. For discrimination of variation from theme the reverse is true; the relevant cues are the variant elements, which might go undetected if only the common elements are attended to. Thus, with development both recognition and discrimination skills ought to improve.

3. *Continuity*. Development allows the individual to deal with stimulus information whose components are widely separated in space and time. Grasping the tonal nature of a musical work requires that the stimuli at each moment be integrated with the initially established tonal centre and with the anticipated conclusion. The expansion and integration of the temporal field with development ought to aid in the detection of false endings.

Gibson (1969) covers these same points much more extensively, emphasising further that development is marked by increasing specificity of discrimination of stimulus features and by the search for invariants in the stimulus field.

The differentiation model of Wohlwill and Gibson provides still another system for understanding the development of musical perception. Comprehensive, parsimonious, and unencumbered by references to complex mentalistic structures, it has influenced our own views.

This brief survey by no means exhausts the possibilities. Recently Levi (1978) has discussed music perception from the perspective of Gestalt theory, while Davies (1978) has examined tune recognition and preference in the light of an information processing model. While neither approach is strictly developmental, both provide the type of overarching view of perception and cognition discussed above. Finally, Neisser (1976) has recently proposed a view of perception which synthesises the contributions of numerous theories—schemata, information processing, hypothesis testing and anticipation, differentiation of information present in the environment—into a more holistic, "ecological" theory. There is no dearth of sophisticated theories at hand for use by the psychologist of music; they merely await application.

Plymouth State College,
New Hampshire.
Nashua,
New Hampshire.

## References


Beilin, H. (1969). Stimulus and cognitive transformation in conservation. In: Elkind, D. and Flavell, J. (eds.): *Studies in Cognitive Development*. New York: Oxford University Press, 409–437.

Botvin, G. (1974). Acquiring conservation of melody and cross-modal transfer through successive approximation. *Journal of Research in Music Education*, **22,** 226–233.

Davies, J. B. (1978). *The Psychology of Music*. Stanford: Stanford University Press.

Dowling, W. and Hollombe, A. (1977). The perception of melodies distorted by splitting into several octaves: effects of increasing proximity and melodic contour. *Perception and Psychophysics*, **21** (1), 60–64.

Flavell, J. (1963). *The Developmental Psychology of Jean Piaget*. Princeton: Van Nostrand.

Foley, E. (1975). Effects of training in conservation of tonal and rhythmic patterns on second grade children. *Journal of Research in Music Education*, **23,** 240–248.

Francès, R. (1958). *La Perception de la Musique*. Paris: Vrin.

Funk, J. (1977). *Some Aspects of the Development of Music Perception*. Unpublished doctoral dissertation, Clark University.

Funk, J. and Whiteside, J. (1980). *The Development of Music Perception: Recognition of Theme and Discrimination of Variation*. Paper presented at the meeting of the Eastern Psychological Association, Hartford, Connecticut, April 1980.

Gardner, H. (1973a). *The Arts and Human Development*. New York: Wiley.

Gardner, H. (1973b). Children's sensitivity to musical styles. *Merrill-Palmer Quarterly*, **19** (1), 67–77.

Gibson, E. (1969). *Principles of Perceptual Learning and Development*, New York: Appleton-Century-Crofts.

Gollin, E. (1956). Some research problems for developmental psychology. *Child Development*, **27,** 223–235.

Imberty, M. (1969). *L'acquisition des Structures Tonales Chez L'enfant*. Paris: Klincksieck.

Inhelder, B. and Piaget, J. (1969). *The Early Growth of Logic in the Child*. New York: Norton.

Levi, D. (1978). Expressive qualities in music perception and music education. *Journal of Research in Music Education*, **26,** 425–435.

Neisser, U. (1976). *Cognition and Reality*. San Francisco: W. H. Freeman.

Norton, D. (1979). Relationship of music ability and intelligence to audition and visual conservation of the kindergarten child. *Journal of Research in Music Education*, **27,** 3–13.

Perney, J. (1976). Musical tasks related to the development of the conservation of metric time. *Journal of Research in Music Education*, **24,** 159–168.

Petzold, R. (1969). Auditory perception by children. *Journal of Research in Music Education* **17,** 82–87.

Pflederer, M. (1964). The responses of children to musical tasks embodying Piaget's principle of conservation. *Journal of Research in Music Education*, **12,** 251–268.

Pflederer, M. (1967). Conservation and the development of musical intelligence. *Journal of Research in Music Education*, **15,** 215–223.

Pflederer-Zimmerman, M. and Sechrest, L. (1970). Brief focused instruction and musical concepts. *Journal of Research in Music Education*, **18,** 25–36.

Piaget, J. (1950). *The Psychology of Intelligence*. New York: Harcourt Brace.

Piaget, J. (1969). *The Mechanisms of Perception*. New York: Basic Books (orig. 1961).

Piaget, J. and Inhelder, B. (1956). *The Child's Conception of Space*. London: Routledge & Kegan Paul.

Prince, W. (1977). Measuring discrimination of complex musical events. *Journal of Research in Music Education*, **25,** 91–99.

Rupp, H. (1915). Uber die Prufung musikalischer Fähigkeiten (Teil I) *Zeitschr. f. angew, Psychol.*, **9,** 1–76.

Shuter, R. (1968). *The Psychology of Musical Ability*. London: Methuen.

Taebel, D. (1974). The effect of various instructional modes on children's performance of music concept tasks. *Journal of Research in Music Education*, **22**, 170–183.
Taylor, J. (1976). Perception of tonality in short melodies. *Journal of Research in Music Education* **24**, 197–208.
Werner, H. (1940). Musical "micro-scales" and "micro-melodies". *Journal of Psychology* **10**, 149–156.
Werner, H. (1961). *Comparative Psychology of Mental Development*. New York: Science Editions.
Wohlwill, J. (1960). Developmental studies of perception. *Psychol. Bull.*, **57**, 249–288.
Wohlwill, J. (1970). From perception to inference: a dimension of cognitive development. *Cognitive Development in Children: Five Monographs of the Society for Research in Child Development*. Chicago: University of Chicago Press, 73–93 (orig. 1962).
Zenatti, A. (1970). Perception mélodique et acculturation tonale. Étude experimentale de l'influence du sexe sur les performances d'enfants agés de 5 à 10 ans. *Sciences de l'Art*, **7** (1–2), 71–76.
Zenatti, A. (1973). Étude de l'acculturation musicale chez l'enfant dans une épreuve d'identification mélodique. *J. de Psychologie Normale et Pathologique*, **4**, 453–464.